Remarks

This amendment is in response to the Office Action mailed March 12, 2003.

Claim Rejections – 35 USC § 112

The Examiner rejected claims 22-42 under 35 U.S.C. Section 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter Applicant regards as the invention.

Claims 22-42 have been cancelled. Claims 43-62 have been added as set forth on the attached replacement pages. Applicant believes the added claims particularly point out and distinctly claim the subject matter Applicant regards as the invention and the added claims therefore comply with the requirements of 35 U.S.C. Section 112, second paragraph.

Specification

Applicant has amended several typographical errors in the originally-filed specification's Detailed Description Of The Invention. Further, Applicant has amended the Brief Description of the Drawings to more accurately describe the figures of the application.

Drawings

As requested by the Examiner, Applicant has amended Figs. 1-5 to correct improper cross-hatching. In addition, Applicant has amended Fig. 1 to include reference number 13c, which was inadvertently omitted from the original drawings.

Applicant believes that the set of claims is in condition for allowance and earnestly requests that the claims pass to issue. If the Examiner believes that contact with Applicant's attorney would aid in the examination of the application, the Examiner may contact Applicants' attorney at the telephone number listed below.

Brief Description Of The Drawings

Figure 1 shows a cross section view of ~~nonconductive bonding material with~~ the preferred embodiment of the invention.

Figure 2 shows a directed top view of ~~a partial heat sink with~~ the preferred embodiment of the invention.

Figure 3 shows a partial cross section view of ~~a partial heat sink with the preferred~~ an embodiment of the invention.

Figure 4 shows a cross-section view of a ~~smartbacking~~ circuit board buildup ~~with~~ incorporating the preferred embodiment of the invention.

Figure 1 shows the preferred embodiment of the invention in a cross section build-up of nonconductive bonding material. The assembled lay-up 10 printed circuit board includes a high power transistor 14 that is positioned on top of a heat sink backing 11 and connected by means of solder 15. The backing 11 is then typically mounted on a pallet. The heat sink backing 11 is any conductive material that includes, but is not limited to, copper, brass, or aluminum. A gap 18 is present around the transistor 14 and the nonconductive bonding material 12, the dielectric 13, ground layer 19, signal layer 16 and solder 15. The filler 17 contacts the signal layer 16, void 18, dielectric 13, solder ~~16~~ 15 and plating 21. The solder 16 is formed by either low temperature or high temperature soldering as required by the design.

The Examiner is hereby authorized to charge any required fees not included herewith to Deposit Account 50-1546.

Respectfully submitted,

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An assembled lay-out 30 of a MMIC printed circuit board is provided to form through-holes. The through-hole 31d and through-hole 31e are depth drilled removing material from the top portion of the MMIC printed circuit board, which in the preferred embodiment of the invention is through the top portion 32a of the first signal layer 32, through the MMIC ~~34~~,34, until the second signal layer 39, and then slightly into the top portion 39a of the second signal layer 39, providing the through holes. Typically, depth-drilling is accomplished by mechanical drilling, constant laser drilling, or pulse laser drilling. The through holes are then plated electrically connecting the first signal layer 32, the MMIC 34 and the second signal layer 39. The plating consists of using a conductive coating that includes, but is not limited to, copper, chrome, aluminum or alloys. Finally, the plated through-hole is filled with a non conductive material which is preferably an epoxy including, but not limited to, polyimide resin, epichloridehydrin bisphenol-A resin (epoxy), or bismaleimidetriazine ("BT") resin, and other heat-curing resins may also be used advantageously. Alternately, after the through-hole is depth drilled it is filled with an electrically conductive filler which is selected from a variety of conductive fillers that electrically connects the first signal layer 32, the MMIC 34 and the second signal layer 39. The conductive fillers include, but are not limited to, copper, brass, aluminum, silver, gold, copper alloys, and the like. Consequently, plating of the through-hole is not required for a connection between the first signal layer 32, MMIC 34 and the second signal layer 39 when electrically conductive filler is used in the through-hole.

The depth drilling forms a first through-hole 58, a blind-hole 59 and a second through-hole 60. At the first through-hole 58 and first access hole 58b, depth-drilling is either mechanical, constant laser or pulse laser. The material from the first side 57a of the first layer 57 through the second layer 56, the third layer 55, the fourth layer 54, the fifth layer 53, the sixth layer 52 and slightly into the seventh layer 51, is removed forming the first through-hole 58 and first access hole 58b. The first through-hole 58 drilling diameter is about 0.90mm with a finish size of 0.80mm, and a first access hole 58b drilling diameter of about 0.60mm with a finish diameter as required by the design parameters of the circuit board. Thus, depth drilling can be used to form through-holes with a variable diameter within the same location of the through-hole. After the first access hole 58b is formed, the edge 58a of the access hole 58b is plated through connecting the backing layer 51, the sixth layer 52, the logic layer 53, the fourth layer 54, the third layer 55 and the dielectric layer 56. Chrome has been found useful for plating, the first edge 58a of the access hole 58b, due to its high strength which is useful in subsequent bond steps. However, as a practitioner in the art understands, copper plating, electroless nickel plating or immersion gold plating is substitutable for chrome. In another application electroless nickel is plated in the range of about 3um-6um and immersion gold is plated in the range of about 0.05um-0.1um. Once the plating step is completed, the first filler 65 is added. The top side 65a of the first filler 65 is shaped either as concave or convex depending on the application. The first filler 65 material is an epoxy including, but not limited to polyimide resin, epichloridehydrin bisphenol-A resin, or bismaleimidetriazine resin, and other heat-curing resins as desired. The through-hole 58 is completely ~~filed~~ filled with the first ~~filer~~ filler 65, and the access hole 58b is partially ~~filed~~ filled with the

first filler 65. The access hole is sometimes completely ~~filed~~ filled with the first filler 65, but typically the filler extends into the access hole 58b to about the fifth layer 53.

The depth drilling forms a blind hole 59. The depth drilling is performed by mechanical means, constant laser means or pulsating laser means. The blind hole 59 is formed by removing material from the first side 56a of the dielectric 56 through the dielectric 56, the fourth layer 54, the fifth layer 53 and partially into the sixth layer 52. Once the depth drilling is complete, a second edge 61 is plated using chrome, copper, nickel or gold, and the like, to form an electrically conductive path from the dielectric 56 to the fifth layer 53. The blind-hole 59 is completely ~~filed~~ filled with a second filler 62, and soldered 63, with a conductive material, that forms an electrically conductive path from the solder 63, to the plated second edge 61, capping the blind hole 59 closed.